Geometric Analysis and Visualization of Maxillofacial Anthropometry

W. Green[1], Y. Hernandez[2], K. H. Kim[3], H.E. Choi-Rokas[4], P. Li[4], T. N. Garlie[4], K.B. Mitchell[4], S. L. Rajulu[5]

[1]Geologics, MA, [2]KBR, TX, [3]Leidos, TX, [4]United States Army Combat Capabilities Development Command Soldier Center, MA, [5]NASA Johnson Space Center, TX

As part of head borne systems, the maxillofacial and mandibular components are critical for Soldier protection in extreme and dynamic conditions. Often this equipment must not only cover the lower face of the wearer, but also accommodate motion of the lower jaw and resultant deformation of the face shape. Although the application is different, head borne equipment designed for astronauts has similarly critical design requirements including comfort and protection from other environmental hazards while allowing for maximum performance. To improve the design of such systems and to ensure adequate accommodation of the user population, NASA Johnson Space Center is collaborating with the U.S. Army's Development Command Soldier Center (DEVCOM SC) to statistically analyze facial landmark and measurement data from large Soldier anthropometric databases (ANSUR 1988 and ANSUR II). Anthropometric measurements were incorporated from 5383 males and 3594 females for analysis, including individuals aged 17-58 across a range of races. Facial landmarks were analyzed, specifically the 3D coordinates of the Menton, Prementon, Gonion, Tragion, Stomion, Zygion, Pronasale, and Subnasale. These data were statistically correlated with demographic characteristics, such as sex and population origin. A statistical model of the lower head-face surface geometry is currently in development to describe the variance of head and face shape across the population. The model will be able to visually show the statistical trends of the different shapes and sizes of the head, along with the synthetically represented boundary cases. The specific analytical methods and outcomes will be detailed in the final proceeding. This study will provide a more comprehensive assessment of how face shape varies across the military population compared to traditional linear measurements. The outcome of this study is expected to provide critical insight and recommendations for improved protective equipment design and development, not only with Soldiers but also astronauts in future exploration missions, as well as first responders and others that require critical equipment fitted to the maxillofacial and or mandibular region.